Portable Ultrasonic Flow Measurement of Liquids

Portable instrument for non-invasive, quick ultrasonic flow measurement with clamp-on technology for all types of piping

Features

- Precise bi-directional and highly dynamic flow measurement with the non-intrusive clamp-on technology
- High precision at fast and slow flow rates, high temperature and zero point stability
- Portable, easy-to-use flow transmitter with 2 flow channels, multiple inputs/outputs, an integrated data logger with a serial interface
- Water and dust-tight (NEMA 4); resistant against oil, many liquids and dirt
- Li-Ion battery provides up to 14 hours of measurement operation
- Automatic loading of calibration data and transducer detection for a fast and easy set-up (less than 5 min), providing precise and long-term stable results
- User-friendly design
- Transducers available for a wide range of inner pipe diameters (0.25...256 in) and fluid temperatures (-40...+752 °F)
- Probe for wall thickness measurement available
- Robust, water-tight (NEMA 6) transport case with comprehensive accessories
- HybridTrek automatically switches between transit time and NoiseTrek mode of measurement when high particulate flows are encountered
- QuickFix for fast mounting of the flow transmitter in difficult conditions

Applications

Designed for the following industries:
- Chemical industry
- Water and wastewater industry
- Oil and gas industry
- Cooling systems and air conditioners
- Facility management
- Aviation industry
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Function

Measurement Principle

Transit Time Difference Principle

In order to measure the flow of a medium in a pipe, ultrasonic signals are used, employing the transit time difference principle. Ultrasonic signals are emitted by a transducer installed on the pipe and received by a second transducer. These signals are emitted alternately in the flow direction and against it.

As the medium in which the signals propagate is flowing, the transit time of the ultrasonic signals in the flow direction is shorter than against the flow direction.

The transit time difference, Δt, is measured and allows the flowmeter to determine the average flow velocity along the propagation path of the ultrasonic signals. A flow profile correction is then performed in order to obtain the area averaged flow velocity, which is proportional to the volumetric flow rate.

Two integrated microprocessors control the entire measuring process. This allows the flowmeter to remove disturbance signals, and to check each received ultrasonic wave for its validity which reduces noise.

HybridTrek

If the gaseous or solid content in the medium increases occasionally during measurement, a measurement with the transit time difference principle is no longer possible. NoiseTrek mode will then be selected by the flowmeter. This measurement method allows the flowmeter to achieve a stable measurement even with high gaseous or solid content.

The transmitter can switch automatically between transit time and NoiseTrek mode without any changes to the measurement setup.

Calculation of Volumetric Flow Rate

\[ \dot{V} = k_{Re} \cdot A \cdot k_a \cdot \Delta t/(2 \cdot t_{fl}) \]

where

- \( \dot{V} \) = volumetric flow rate
- \( k_{Re} \) = fluid mechanics calibration factor
- \( A \) = cross-sectional pipe area
- \( k_a \) = acoustical calibration factor
- \( \Delta t \) = transit time difference
- \( t_{fl} \) = transit time in the medium
Number of Sound Paths

The number of sound paths is the number of transits of the ultrasonic signal through the medium in the pipe. Depending on the number of sound paths, the following methods of installation exist:

- **reflect mode**
  The number of sound paths is even. Both of the transducers are mounted on the same side of the pipe. Correct positioning of the transducers is easier.

- **diagonal mode**
  The number of sound paths is odd. Both of the transducers are mounted on opposite sides of the pipe.

- **direct mode**
  Diagonal mode with 1 sound path. This should be used in the case of a high signal attenuation by the medium, pipe or coatings.

The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the transmitter.

As the transducers can be mounted with the transducer mounting fixture in reflect mode or diagonal mode, the number of sound paths can be adjusted optimally for the application.
Typical Measurement Setup

Example of a measurement setup in reflect mode

Example of a heat flow measurement
Flow Transmitter

Technical Data

| FLUXUS F601 |  
|---|---|
| design | portable  

**measurement**

| measurement principle | transit time difference correlation principle, automatic NoiseTrek selection for measurements with high gaseous or solid content  
|---|---|
| flow velocity | 0.03 to 82 ft/s  
| repeatability | 0.15 % of reading ±0.03 ft/s  
| medium | all acoustically conductive liquids with < 10 % gaseous or solid content in volume (transit time difference principle)  
| temperature compensation | corresponding to the recommendations in ANSI/ASME MFC-5M-1985  
| accuracy | ±1.6 % of reading ±0.03 ft/s ±1.2 % of reading ±0.03 ft/s ±0.5 % of reading ±0.03 ft/s  

**flow transmitter**

| power supply | 100 to 240 V/50 to 60 Hz (power supply unit), 10.5 to 15 V DC (socket at transmitter), integrated battery  
| battery | Li-Ion, 7.2 V/4.5 Ah  
| power consumption | <6 W  
| number of flow measuring channels | 2  
| signal attenuation | 0 to 100 s, adjustable  
| measuring cycle (1 channel) | 100 to 1000 Hz  
| response time | 1 s (1 channel), option: 70 ms  
| housing material | PA, TPE, AutoTex, stainless steel  
| degree of protection | NEMA 4  
| dimensions | see dimensional drawing  
| weight | 4.2 lb  
| fixation | QuickFix pipe mounting fixture  
| operating temperature | 14 to 140 °F  
| display | 2 x 16 characters, dot matrix, backlight  
| menu language | English, German, French, Dutch, Spanish  

**measuring functions**

| physical quantities | volumetric flow rate, mass flow rate, flow velocity, heat flow (if temperature inputs are installed)  
| totalizer | volume, mass, optional: heat quantity  
| calculation functions | average, difference, sum  
| diagnostic functions | sound speed, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times  

**data logger**

| loggable values | all physical quantities, totalized values and diagnostic values  
| capacity | > 100 000 measured values  

1 for transit time difference principle, reference conditions and v > 0.49 ft/s
2 reference uncertainty < 0.2 %
**FLUXUS F601**

<table>
<thead>
<tr>
<th><strong>communication</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>interface</td>
<td>RS232/USB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>serial data kit</strong></th>
<th></th>
</tr>
</thead>
</table>
| software (all Windows™ versions) | - FluxData: download of measurement data, graphical presentation, conversion to other formats (e.g. for Excel™)  
- FluxKoef: creating medium data sets |
| cable               | RS232 |
| adapter             | RS232 - USB |

<table>
<thead>
<tr>
<th><strong>transport case</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>dimensions</td>
<td>19.7 x 15.7 x 7.5 in</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>outputs</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>number</td>
<td>see standard scope of supply on page 9, max. on request</td>
</tr>
<tr>
<td>accessories</td>
<td>output adapter (if number of outputs &gt; 4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>current output</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>range</td>
<td>0/4 to 20 mA</td>
</tr>
<tr>
<td>accuracy</td>
<td>0.1 % of reading ±15 μA</td>
</tr>
<tr>
<td>active output</td>
<td>R_{ext} &lt; 200 Ω</td>
</tr>
</tbody>
</table>
| passive output    | U_{ext} = 4 to 16 V, depending on R_{ext}  
R_{ext} < 500 Ω |

<table>
<thead>
<tr>
<th><strong>frequency output</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>range</td>
<td>0 to 5 kHz</td>
</tr>
<tr>
<td>open collector</td>
<td>24 V/4 mA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>binary output</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>voltage</td>
<td>26 V/100 mA</td>
</tr>
</tbody>
</table>
| type               | binary output as alarm output  
- functions: limit, change of flow direction or error |
| range              | binary output as pulse output  
- pulse value: 0.01 to 1000 units  
- pulse width: 1 to 1000 ms |

<table>
<thead>
<tr>
<th><strong>inputs</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>number</td>
<td>see standard scope of supply on page 9, max. 4</td>
</tr>
<tr>
<td>accessories</td>
<td>input adapter (if number of inputs &gt; 2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>temperature input</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td>PT100/PT1000</td>
</tr>
<tr>
<td>connection</td>
<td>4-wire</td>
</tr>
<tr>
<td>range</td>
<td>-238 to +1040 °F</td>
</tr>
<tr>
<td>resolution</td>
<td>0.01 K</td>
</tr>
<tr>
<td>accuracy</td>
<td>±0.01 % of reading ±0.03 K</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>current input</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>accuracy</td>
<td>0.1 % of reading ±10 μA</td>
</tr>
<tr>
<td>passive input</td>
<td>R_i = 50 Ω, P_i &lt; 0.3 W</td>
</tr>
<tr>
<td>range</td>
<td>-20 to +20 mA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>voltage input</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>range</td>
<td>0 to 1 V</td>
</tr>
<tr>
<td>accuracy</td>
<td>0.1 % of reading ±1 mV</td>
</tr>
<tr>
<td>internal resistance</td>
<td>R_i = 1 MΩ</td>
</tr>
</tbody>
</table>
Dimensions

**FLUXUS F601**

in inch
## Standard Scope of Supply

<table>
<thead>
<tr>
<th></th>
<th>F601 Standard</th>
<th>F601 Energy</th>
<th>F601 Double Energy</th>
<th>F601 Multifunctional</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>application</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>flow measurement on liquids</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 independent measuring channels</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>temperature-compensated calculation of mass flow rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>integrated heat flow computer for monitoring of energy flows</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>simultaneous monitoring of energy flow and flow, e.g. heating systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>simultaneous monitoring of 2 energy flows, e.g. heating systems, heat exchangers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>flow measurement taking into account other process quantities, e.g. density, viscosity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>outputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>passive current output</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>binary output</td>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>inputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>temperature input</td>
<td>-</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>passive current input</td>
<td>-</td>
<td>-</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>accessories</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>transport case</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>power supply unit, mains cable</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>battery</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>output adapter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>input adapter</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>adapter for voltage and current inputs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>QuickFix pipe mounting fixture for transmitter</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>serial data kit</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>measuring tape</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>user manual, Quick Start Guide</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>connector board at the upper side of the transmitter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Connection of Adapters

output adapter

input adapter

adapter for voltage and current inputs

transducers measuring channel A

transducers measuring channel B

RS232

outputs

inputs

power supply unit/battery charging unit
Example for the Equipment of a Transport Case
Transducers

Transducer Selection

<table>
<thead>
<tr>
<th>Transducer</th>
<th>transducer order code</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSK</td>
<td>3.9 7.9 14.1 25.6</td>
</tr>
<tr>
<td>FSM</td>
<td>2 3.9 7.9 14.2</td>
</tr>
<tr>
<td>FSQ</td>
<td>0.39 0.98 5.9 15.7</td>
</tr>
<tr>
<td>FSS</td>
<td>0.24 0.39 2.8</td>
</tr>
</tbody>
</table>

inner pipe diameter [in]

- **FSK**: Recommended
- **FSM**: Possible
- **FSQ**: Recommended
- **FSS**: Recommended
## Transducer Order Code

<table>
<thead>
<tr>
<th>Transducer</th>
<th>Transducer frequency</th>
<th>Operating temperature</th>
<th>Explosion protection</th>
<th>Connection system</th>
<th>Extension cable</th>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>set of ultrasonic flow transducers for liquids measurement, shear wave</td>
</tr>
<tr>
<td>K</td>
<td>0.5 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5 MHz</td>
</tr>
<tr>
<td>M</td>
<td>1 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 MHz</td>
</tr>
<tr>
<td>Q</td>
<td>4 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 MHz</td>
</tr>
<tr>
<td>S</td>
<td>8 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8 MHz</td>
</tr>
<tr>
<td>N</td>
<td>normal temperature range</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>normal temperature range</td>
</tr>
<tr>
<td>E</td>
<td>extended temperature range (shear wave transducers with transducer frequency M, Q)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>extended temperature range</td>
</tr>
<tr>
<td>NN</td>
<td>not explosion proof</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>not explosion proof</td>
</tr>
<tr>
<td>NL</td>
<td>with Lemo connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>with Lemo connector</td>
</tr>
<tr>
<td>XXX</td>
<td>cable length in m, for max. length of extension cable see page 22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>cable length in m, for max. length of extension cable</td>
</tr>
<tr>
<td>LC</td>
<td>long transducer cable (only FSK)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>long transducer cable</td>
</tr>
</tbody>
</table>

**Example:**

FS M - N NN NL - 000 shear wave transducer 1 MHz, normal temperature range, connection system NL with Lemo connector

- - - /
Technical Data

Shear Wave Transducers

<table>
<thead>
<tr>
<th>technical type</th>
<th>CDK1NZ7</th>
<th>CLK1NZ7</th>
<th>CDM1NZ7</th>
</tr>
</thead>
<tbody>
<tr>
<td>order code</td>
<td>FSK-NNNL</td>
<td>FSK-NNNL/LC</td>
<td>FSM-NNNL</td>
</tr>
<tr>
<td>transducer frequency MHz</td>
<td>0.5</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>inner pipe diameter d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>min. extended</td>
<td>in 3.9</td>
<td>3.9</td>
<td>2</td>
</tr>
<tr>
<td>max. recommended</td>
<td>in 7.9</td>
<td>7.9</td>
<td>3.9</td>
</tr>
<tr>
<td>max. extended</td>
<td>in 255.9</td>
<td>255.9</td>
<td>133.9</td>
</tr>
<tr>
<td>pipe wall thickness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>min.</td>
<td>in -</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>max.</td>
<td>in -</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>housing</td>
<td>PEEK with stainless steel cap 304</td>
<td>PEEK with stainless steel cap 304</td>
<td>stainless steel 304</td>
</tr>
<tr>
<td>contact surface</td>
<td>PEEK</td>
<td>PEEK</td>
<td>PEEK</td>
</tr>
<tr>
<td>degree of protection</td>
<td>NEMA 6</td>
<td>NEMA 6</td>
<td>NEMA 6</td>
</tr>
<tr>
<td>transducer cable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>type length</td>
<td>ft 1699</td>
<td>1699</td>
<td>1699</td>
</tr>
<tr>
<td>length</td>
<td>16</td>
<td>29</td>
<td>13</td>
</tr>
<tr>
<td>dimensions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>length l</td>
<td>in 4.98</td>
<td>4.98</td>
<td>2.36</td>
</tr>
<tr>
<td>width b</td>
<td>in 2.01</td>
<td>2.01</td>
<td>1.18</td>
</tr>
<tr>
<td>height h</td>
<td>in 2.66</td>
<td>2.66</td>
<td>1.32</td>
</tr>
<tr>
<td>dimensional drawing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>operating temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>min.</td>
<td>°F -40</td>
<td>-40</td>
<td>-40</td>
</tr>
<tr>
<td>max.</td>
<td>°F +266</td>
<td>+266</td>
<td>+266</td>
</tr>
<tr>
<td>temperature compensation</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
# Shear Wave Transducers

<table>
<thead>
<tr>
<th>technical type</th>
<th>CDQ1NZ7</th>
<th>CDS1NZ7</th>
</tr>
</thead>
<tbody>
<tr>
<td>order code</td>
<td>FSQ-NNNL</td>
<td>FSS-NNNL</td>
</tr>
<tr>
<td>transducer frequency MHz</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>inner pipe diameter d</td>
<td></td>
<td></td>
</tr>
<tr>
<td>min. extended in</td>
<td>0.39</td>
<td>0.24</td>
</tr>
<tr>
<td>min. recommended in</td>
<td>0.98</td>
<td>0.39</td>
</tr>
<tr>
<td>max. recommended in</td>
<td>5.9</td>
<td>2.8</td>
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<tr>
<td>max. extended in</td>
<td>15.7</td>
<td>2.8</td>
</tr>
<tr>
<td>pipe wall thickness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>min. in</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>max. in</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>material</td>
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<td></td>
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<tr>
<td>housing</td>
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<td>stainless steel 304</td>
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<td>PEEK</td>
<td>PEI</td>
</tr>
<tr>
<td>degree of protection</td>
<td>NEMA 6</td>
<td>NEMA 4</td>
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<tr>
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<td>type 1699</td>
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<td>9</td>
<td>6</td>
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<tr>
<td>dimensions</td>
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<td>0.51</td>
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<td>0.67</td>
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<td></td>
<td>max. °F</td>
<td>+266</td>
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<td></td>
<td>temperature compensation</td>
<td>x</td>
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Shear Wave Transducers (extended temperature range)

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<th>CDQ1EZ7</th>
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<td>FSM-ENNNL</td>
<td>FSQ-ENNNL</td>
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<tr>
<td>Transducer Frequency</td>
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<td>1</td>
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<tr>
<td>Inner Pipe Diameter d</td>
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<td></td>
</tr>
<tr>
<td>Min. Extended</td>
<td>in</td>
<td>2</td>
</tr>
<tr>
<td>Min. Recommended</td>
<td>in</td>
<td>3.9</td>
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<tr>
<td>Max. Recommended</td>
<td>in</td>
<td>78.7</td>
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<tr>
<td>Max. Extended</td>
<td>in</td>
<td>133.9</td>
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<td>Pipe Wall Thickness</td>
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<tr>
<td>Min.</td>
<td>in</td>
<td>-</td>
</tr>
<tr>
<td>Max.</td>
<td>in</td>
<td>-</td>
</tr>
<tr>
<td>Material</td>
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<td></td>
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<tr>
<td>Housing</td>
<td>stainless steel 304</td>
<td>stainless steel 304</td>
</tr>
<tr>
<td>Contact Surface</td>
<td>Sintimid</td>
<td>Sintimid</td>
</tr>
<tr>
<td>Degree of Protection</td>
<td>NEMA 4</td>
<td>NEMA 4</td>
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<tr>
<td>Transducer Cable</td>
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<td></td>
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<tr>
<td>Type</td>
<td>1699</td>
<td>1699</td>
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<tr>
<td>Length</td>
<td>ft</td>
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<tr>
<td>Dimensions</td>
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<td>Length l</td>
<td>in</td>
<td>2.36</td>
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<td>Width b</td>
<td>in</td>
<td>1.18</td>
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<td>Height h</td>
<td>in</td>
<td>1.32</td>
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<td>Dimensional Drawing</td>
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<tr>
<td>Operating Temperature</td>
<td></td>
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</tr>
<tr>
<td>Min.</td>
<td>°F</td>
<td>-22</td>
</tr>
<tr>
<td>Max.</td>
<td>°F</td>
<td>+392</td>
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<tr>
<td>Temperature Compensation</td>
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## Transducer Mounting Fixture

### Order Code

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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7 to 9</th>
<th>no. of character</th>
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<tbody>
<tr>
<td>transducer mounting fixture</td>
<td>transducer</td>
<td>group transducer</td>
<td>size</td>
<td>fixation</td>
<td>outer pipe diameter</td>
<td>description</td>
<td></td>
</tr>
<tr>
<td>FS</td>
<td>LM</td>
<td>VP</td>
<td>TB</td>
<td>WL</td>
<td>A</td>
<td>K</td>
<td>M</td>
</tr>
<tr>
<td>mounting frames</td>
<td>ladder chain mounting accessory</td>
<td>portable Variofix</td>
<td>tension belts</td>
<td>transducer clamping fixture for WaveInjector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>all transducers</td>
<td>transducers with transducer frequency K</td>
<td>transducers with transducer frequency M</td>
<td>transducers with transducer frequency Q</td>
<td>transducers with transducer frequency S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reflect mode or diagonal mode/direct mode</td>
<td>reflect mode</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>small</td>
<td>medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chains</td>
<td>without fixation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5 to 8 in</td>
<td>0.5 to 22 in</td>
<td>0.39 to 3.9 in</td>
<td>0.39 to 9.8 in</td>
<td>0.39 to 21.7 in</td>
<td>2 to 59.1 in</td>
<td>2 to 82.7 in</td>
<td></td>
</tr>
</tbody>
</table>

**example**

| VP | M | - | D | M | - | C | 055 | portable Variofix and chains for transducers with transducer frequency M | - | - |
mounting frames FS and chains

transducer frequency: M, Q
material: stainless steel 304, 301, 303
dimensions: 16.54 x 1.89 x 2.68 in
chain length: 1/3/6 ft
outer pipe diameter: max. 5.9/12.2/23.6 in

transducer frequency: S
material: stainless steel 304, 301, 303
dimensions: 8.27 x 1.26 x 1.73 in
chain length: 1 ft
outer pipe diameter: max. 5.9 in

mounting frames FS and magnet (optional)

material: stainless steel 304, 301, 303
dimensions: 16.54 x 2.17 x 2.68 in
ladder chain mounting accessory LM

transducer frequency: M, Q
chain length: 30/78 in
outer pipe diameter: max. 24 in

portable Variofix VP and chains

material: stainless steel 304, 301, 303
dimensions: 16.3 x 3.7 x 2.99 in
chain length: 6 ft

portable Variofix VP and magnet (optional)

material: stainless steel 304, 301, 303
dimensions: 16.3 x 3.7 x 1.57 in
tension belts TB (optional)

- transducer frequency: K
- material: steel, powder coated and textile tension belt
- length: 16/22 ft
- operating temperature: max. 140 °F
- outer pipe diameter: max. 59.1/82.7 in

transducer clamping fixture for WavelInjector WL

see Technical Specification TSWavelInjectorVx-x
### Coupling Materials for Transducers

<table>
<thead>
<tr>
<th></th>
<th>normal temperature range (4th character of transducer order code = N)</th>
<th>extended temperature range (4th character of transducer order code = E)</th>
<th>WavelInjecto WI-400</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2 h</td>
<td>coupling compound type N</td>
<td>coupling compound type E</td>
<td>coupling foil type A</td>
</tr>
<tr>
<td></td>
<td>&lt; 212 °F</td>
<td>&lt; 302 °F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>212 to 338 °F</td>
<td>302 to 392 °F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt; 536 °F</td>
<td>536 to 752 °F</td>
<td></td>
</tr>
<tr>
<td>&lt; 24 h</td>
<td>coupling compound type N</td>
<td>coupling compound type E</td>
<td>coupling foil type B</td>
</tr>
<tr>
<td></td>
<td>&lt; 22 to +266 °F</td>
<td>&lt; 22 to +392 °F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mineral grease paste</td>
<td>silicone paste</td>
<td></td>
</tr>
<tr>
<td>&lt; 3 months</td>
<td>coupling compound type N</td>
<td>coupling foil type VT</td>
<td>coupling foil type B</td>
</tr>
<tr>
<td></td>
<td>coupling compound type E</td>
<td>coupling foil type VT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt; 24 to +482 °F</td>
<td>max. 392</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fluoropolymeer paste</td>
<td>plomb</td>
<td></td>
</tr>
<tr>
<td></td>
<td>coupling foil type A</td>
<td>coupling foil type B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>max. 536</td>
<td>&gt; 536 to 752</td>
<td></td>
</tr>
<tr>
<td></td>
<td>silver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>coupling foil type VT</td>
<td>14 to 302, short-time peak max. 392</td>
<td>fluoroelastomer</td>
<td>for transducers with transducer frequency G, H, K</td>
</tr>
<tr>
<td>990739-0</td>
<td></td>
<td></td>
<td>for shear wave transducers with transducer frequency M, P</td>
</tr>
<tr>
<td>990739-6</td>
<td></td>
<td></td>
<td>for shear wave transducers with transducer frequency M, P</td>
</tr>
<tr>
<td>990739-14</td>
<td></td>
<td></td>
<td>for Lambwave transducers with transducer frequency Q</td>
</tr>
<tr>
<td>990739-15</td>
<td></td>
<td></td>
<td>for Lambwave transducers with transducer frequency Q</td>
</tr>
<tr>
<td>990739-5</td>
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Coupling foil not to be used for transducer mounting fixture with magnets

### Technical Data

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<tr>
<th>type</th>
<th>order code</th>
<th>operating temperature °F</th>
<th>material</th>
<th>remark</th>
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<tbody>
<tr>
<td>coupling compound</td>
<td>990739-1</td>
<td>-22 to +266</td>
<td>mineral grease paste</td>
<td>for transducers with transducer frequency G, H, K</td>
</tr>
<tr>
<td>type N</td>
<td></td>
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</tr>
<tr>
<td>coupling compound</td>
<td>990739-2</td>
<td>-22 to +392</td>
<td>silicone paste</td>
<td>for shear wave transducers with transducer frequency M, P</td>
</tr>
<tr>
<td>type E</td>
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<tr>
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<td>990739-3</td>
<td>-22 to +482</td>
<td>fluoropolymer paste</td>
<td>for shear wave transducers with transducer frequency M, P</td>
</tr>
<tr>
<td>type H</td>
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<td></td>
</tr>
<tr>
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<td>plomb</td>
<td></td>
</tr>
<tr>
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<td></td>
<td>for shear wave transducers IP68 and Lambwave transducers with transducer frequency M, P</td>
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<tr>
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<td>14 to 302, short-time peak max. 392</td>
<td>fluoroelastomer</td>
<td>for transducers with transducer frequency Q</td>
</tr>
<tr>
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<td>990739-14</td>
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<td>990739-15</td>
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<td>990739-5</td>
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Connection Systems

connection system NL

![Connection System Diagram]

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<th>transducer frequency (3d character of transducer order code)</th>
<th>G, H, K</th>
<th>M, P</th>
<th>Q</th>
<th>S</th>
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<tbody>
<tr>
<td>N L cable length ft</td>
<td>x</td>
<td>y</td>
<td>l&lt;sup&gt;1&lt;/sup&gt;</td>
<td>x</td>
</tr>
<tr>
<td>cable length (option LC) ft</td>
<td>6</td>
<td>22</td>
<td>≤ 82</td>
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</tbody>
</table>

<sup>1</sup> > 82 to 328 ft on request

x, y = transducer cable length
l = max. length of extension cable

Transducer Cable

Technical Data

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<th>extension cable</th>
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<td>2551</td>
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<td>see table above</td>
<td>16</td>
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<td>max. length ft</td>
<td>-</td>
<td>32</td>
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<tr>
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<td>-13 to +176</td>
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<tr>
<td>sheath</td>
<td></td>
<td></td>
</tr>
<tr>
<td>material</td>
<td>stainless steel</td>
<td></td>
</tr>
<tr>
<td>outer diameter in</td>
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<td>-</td>
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<tr>
<td>cable jacket</td>
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<td>TPE-O</td>
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<tr>
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<td>black</td>
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<tr>
<td>shield</td>
<td>x</td>
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Clamp-on Temperature Probe (optional)

Technical Data

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<th>PT13N</th>
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<td>670412-2</td>
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<td>4-wire</td>
<td>4-wire</td>
<td>4-wire</td>
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<td>connection</td>
<td>4-wire</td>
<td>4-wire</td>
<td>4-wire</td>
<td>4-wire</td>
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<tr>
<td>measuring range</td>
<td>°F</td>
<td>-22 to +482</td>
<td>-58 to +482</td>
<td>-58 to +482</td>
</tr>
<tr>
<td>accuracy T</td>
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<td>±(0.27 °F + 2 · 10⁻³·(T [°F] - 32 °F)), class A</td>
<td>±(0.27 °F + 2 · 10⁻³·(T [°F] - 32 °F)), class A</td>
<td>±(0.27 °F + 2 · 10⁻³·(T [°F] - 32 °F)), class A</td>
</tr>
<tr>
<td>accuracy ΔT</td>
<td>±(0.1 K, (3K &lt; ΔT &lt; 6 K), more corresponding to EN 1434-1)</td>
<td>±(0.1 K, (3K &lt; ΔT &lt; 6 K), more corresponding to EN 1434-1)</td>
<td>±(0.1 K, (3K &lt; ΔT &lt; 6 K), more corresponding to EN 1434-1)</td>
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<tr>
<td>response time</td>
<td>s</td>
<td>50</td>
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<td>8</td>
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<tr>
<td>housing</td>
<td>aluminum</td>
<td>PEEK, stainless steel 304, copper</td>
<td>PEEK, stainless steel 304, copper</td>
<td>PEEK, stainless steel 304, copper</td>
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<td>degree of protection</td>
<td>NEMA 4</td>
<td>NEMA 4</td>
<td>NEMA 4</td>
<td>NEMA 4</td>
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<tr>
<td>weight (without connector)</td>
<td>lb</td>
<td>0.6</td>
<td>1.1</td>
<td>0.7</td>
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<tr>
<td>fixation</td>
<td>clamp-on</td>
<td>clamp-on</td>
<td>clamp-on</td>
<td>clamp-on</td>
</tr>
<tr>
<td>accessories</td>
<td>-</td>
<td>plastic protection plate, insulation foam</td>
<td>plastic protection plate, insulation foam</td>
<td>plastic protection plate, insulation foam</td>
</tr>
<tr>
<td>dimensions</td>
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</tr>
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<td>width b</td>
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<td>height h</td>
<td>in</td>
<td>0.79</td>
<td>1.06</td>
<td>1.06</td>
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<tr>
<td>dimensional drawing</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>B</td>
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</table>

Connection

Temperature Probe

Connector

<table>
<thead>
<tr>
<th>pin</th>
<th>cable of temperature probe</th>
<th>extension cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>white/blue</td>
<td>blue</td>
</tr>
<tr>
<td>2</td>
<td>red/blue</td>
<td>gray</td>
</tr>
<tr>
<td>3, 4, 5</td>
<td>not connected</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>red</td>
<td>red</td>
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<tr>
<td>7</td>
<td>white</td>
<td>white</td>
</tr>
<tr>
<td>8</td>
<td>not connected</td>
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</tr>
</tbody>
</table>

Cable

<table>
<thead>
<tr>
<th>type</th>
<th>cable of temperature probe</th>
<th>extension cable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 x 0.25 mm² black or white</td>
<td>LIYC 8 x 0.14 mm² gray</td>
</tr>
<tr>
<td></td>
<td>standard length ft</td>
<td>16/32/82</td>
</tr>
<tr>
<td></td>
<td>max. length ft</td>
<td>656</td>
</tr>
<tr>
<td></td>
<td>cable jacket</td>
<td>PVC</td>
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</tbody>
</table>
Wall Thickness Measurement (optional)

The pipe wall thickness is an important pipe parameter which has to be determined exactly for a good measurement. However, the pipe wall thickness often is unknown.

The wall thickness probe can be connected to the transmitter instead of the flow transducers and the wall thickness measurement mode is activated automatically. Acoustic coupling compound is applied to the wall thickness probe which then is placed firmly on the pipe. The wall thickness is displayed and can be stored directly in the transmitter.

Technical Data

<table>
<thead>
<tr>
<th>Technical type</th>
<th>DWQ1xZ7</th>
<th>DWP1EZ7</th>
</tr>
</thead>
<tbody>
<tr>
<td>reverse polarity protected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>measuring range</td>
<td>in</td>
<td>0.04 to 7.9</td>
</tr>
<tr>
<td>resolution</td>
<td>in</td>
<td>0.0004</td>
</tr>
<tr>
<td>accuracy</td>
<td>% ± 0.02 in</td>
<td></td>
</tr>
<tr>
<td>operating temperature</td>
<td>°F</td>
<td>-4 to +140</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-4 to +392, short-time peak max. 1004</td>
</tr>
<tr>
<td>cable length</td>
<td>ft</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

1 The measuring range depends on the attenuation of the ultrasonic signal in the pipe. For strongly attenuating plastics (e.g. PFA, PTFE, PP) the measuring range is smaller.